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DEVELOPING SAFETY-CRITICAL SOFTWARE

A Practical Guide for Aviation Software and DO-178C Compliance

LEANNA RIERSON



**Developing Safety Critical Software A Practical Guide
For Aviation Software And Do 178c
Compliance**

**Stacy Nelson, Nasa Technical Reports
Server (Ntrs)**

Developing Safety Critical Software A Practical Guide For Aviation Software And Do 178c Compliance **Safety Critical Software**

Developing Safety-Critical Software Leanna Rierson, 2017-12-19 The amount of software used in safety critical systems is increasing at a rapid rate At the same time software technology is changing projects are pressed to develop software faster and more cheaply and the software is being used in more critical ways Developing Safety Critical Software A Practical Guide for Aviation Software and DO 178C Compliance equips you with the information you need to effectively and efficiently develop safety critical life critical and mission critical software for aviation The principles also apply to software for automotive medical nuclear and other safety critical domains An international authority on safety critical software the author helped write DO 178C and the U S Federal Aviation Administration s policy and guidance on safety critical software In this book she draws on more than 20 years of experience as a certification authority an avionics manufacturer an aircraft integrator and a software developer to present best practices real world examples and concrete recommendations The book includes An overview of how software fits into the systems and safety processes Detailed examination of DO 178C and how to effectively apply the guidance Insight into the DO 178C related documents on tool qualification DO 330 model based development DO 331 object oriented technology DO 332 and formal methods DO 333 Practical tips for the successful development of safety critical software and certification Insightful coverage of some of the more challenging topics in safety critical software development and verification including real time operating systems partitioning configuration data software reuse previously developed software reverse engineering and outsourcing and offshoring An invaluable reference for systems and software managers developers and quality assurance personnel this book provides a wealth of information to help you develop manage and approve safety critical software more confidently Development of Safety-Critical Systems Gopinath Karmakar, Amol Wakankar, Ashutosh Kabra, Paritosh Pandya, 2023-10-09 This book provides professionals and students with practical guidance for the development of safety critical computer based systems It covers important aspects ranging from complying with standards and guidelines to the necessary software development process and tools and also techniques pertaining to model based application development platforms as well as qualified programmable controllers After a general introduction to the book s topic in chapter 1 chapter 2 discusses dependability aspects of safety systems and how architectural design at the system level helps deal with failures and yet achieves the targeted dependability attributes Chapter 3 presents the software development process which includes verification and validation at every stage essential to the development of software for systems performing safety functions It also explains how the process helps in developing a safety case that can be independently verified and validated The subsequent chapter 4 presents some important standards and guidelines which apply to different industries and in different countries Chapter 5 then discusses the steps towards complying with the standards at every phase of development It offers a guided tour traversing the path of software

qualification by exploring the necessary steps towards achieving the goal with the help of case studies Chapter 6 highlights the application of formal methods for the development of safety systems software and introduces some available notations and tools which assist the process Finally chapter 7 presents a detailed discussion on the importance and the advantages of qualified platforms for safety systems application development including programmable controller PLC and formal model based development platforms Each chapter includes case studies illustrating the subject matter The book is aimed at both practitioners and students interested in the art and science of developing computer based systems for safety critical applications Both audiences will get insights into the tools and techniques along with the latest developments in the design analysis and qualification which are constrained by the regulatory and compliance requirements mandated by the applicable guides and standards It also addresses the needs of professionals and young graduates who specialize in the development of necessary tools and qualified platforms

Design and Safety Assessment of Critical Systems Marco Bozzano,Adolfo Villafiorita,2010-11-12 Safety critical systems by definition those systems whose failure can cause catastrophic results for people the environment and the economy are becoming increasingly complex both in their functionality and their interactions with the environment Unfortunately safety assessments are still largely done manually a time consuming and error prone

Software Development Tools for Safety-critical, Real-time Systems Handbook ,2007 **Certification Processes for Safety-Critical and Mission-Critical Aerospace Software** National Aeronautics and Space Administration (NASA),2018-05-29 This document is a quick reference guide with an overview of the processes required to certify safety critical and mission critical flight software at selected NASA centers and the FAA Researchers and software developers can use this guide to jumpstart their understanding of how to get new or enhanced software onboard an aircraft or spacecraft The introduction contains aerospace industry definitions of safety and safety critical software as well as the current rationale for certification of safety critical software The Standards for Safety Critical Aerospace Software section lists and describes current standards including NASA standards and RTCA DO 178B The Mission Critical versus Safety Critical software section explains the difference between two important classes of software safety critical software involving the potential for loss of life due to software failure and mission critical software involving the potential for aborting a mission due to software failure The DO 178B Safety critical Certification Requirements section describes special processes and methods required to obtain a safety critical certification for aerospace software flying on vehicles under auspices of the FAA The final two sections give an overview of the certification process used at Dryden Flight Research Center and the approval process at the Jet Propulsion Lab JPL Nelson StacyAmes Research Center

CERTIFICATION COMPUTER PROGRAMS AEROSPACE SAFETY AIRCRAFT SAFETY AIRBORNE SPACEBORNE COMPUTERS FLIGHT SAFETY FAILURE Certification Processes for Safety-Critical and Mission-Critical Aerospace Software Stacy Nelson,Nasa Technical Reports Server (Ntrs),2013-08 This document is a quick reference guide with an overview of the processes required to certify safety critical and mission critical flight software

at selected NASA centers and the FAA Researchers and software developers can use this guide to jumpstart their understanding of how to get new or enhanced software onboard an aircraft or spacecraft The introduction contains aerospace industry definitions of safety and safety critical software as well as the current rationale for certification of safety critical software The Standards for Safety Critical Aerospace Software section lists and describes current standards including NASA standards and RTCA DO 178B The Mission Critical versus Safety Critical software section explains the difference between two important classes of software safety critical software involving the potential for loss of life due to software failure and mission critical software involving the potential for aborting a mission due to software failure The DO 178B Safety critical Certification Requirements section describes special processes and methods required to obtain a safety critical certification for aerospace software flying on vehicles under auspices of the FAA The final two sections give an overview of the certification process used at Dryden Flight Research Center and the approval process at the Jet Propulsion Lab JPL

Development and Verification of Software for Flight Safety Critical Systems H. Afzali, A. Mattissek, LITEF DER HELIGE GMBH FREIBURG IM BREISGAU (GERMANY F R), 1991 In Flight Safety Critical Systems where the lives of people and or mission success is depending on errors in the Computer Software Components can have a catastrophic impact on the safety The requirements for the software development and maintenance of Flight Safety Critical systems differ in some aspects from the systems which do not fall into this category The reason for these requirement is to produce the right product at the very beginning of the system s usage and to ensure special attention is paid throughout the whole service life of the equipment The reliability and safety requirements can reach a point where testing alone is not sufficient Consequently adequate control mechanisms have to be applied The software configuration management quality control verification and validation must be rigorously adhered to For the development of the equipment software a set of development standards and additional procedures for the implementation of Safety Critical Functions are defined LITEF applied the standards and procedures for the development of the Inertial Measurement Unit which is a part of the Flight Control System and Seat Sequencer Unit which is part of the Ejection Seat In this paper some critical technology needs are described for supporting the development and verification process of such systems and the activities which have to be performed during the development phases for identifying assessing and eliminating or minimizing hazards in a systematic way **A Strategy for**

Identification and Development of Safety Critical Software Embedded in Complex Space Systems Jürgen

Wunram, 1990 A System-Theoretic Safety Engineering Approach for Software-Intensive Systems Asim Ali Ahmed

Abdulkhaleq, 2017-02-23 Software safety is a crucial aspect during the development of modern safety critical systems However safety is a system level property and therefore must be considered at the system level to ensure the whole system s safety In the software development process formal verification and functional testing are complementary approaches which are used to verify the functional correctness of software however even perfectly reliable software could lead to an accident

The correctness of software cannot ensure the safe operation of safety critical software systems Therefore developing safety critical software requires a more systematic software and safety engineering process that enables the software and safety engineers to recognize the potential software risks For this purpose this dissertation introduces a comprehensive safety engineering approach based on STPA for Software Intensive Systems called STPA SwISs which provides seamless STPA safety analysis and software safety verification activities to allow the software and safety engineers to work together during the software development for safety critical systems and help them to recognize the associated software risks at the system level

Airborne Electronic Hardware Design Assurance Randall Fulton, Roy Vandermolen, 2014-12-15 Written by a Federal Aviation Administration FAA consultant designated engineering representative DER and an electronics hardware design engineer who together taught the DO 254 class at the Radio Technical Commission for Aeronautics Inc RTCA in Washington District of Columbia USA Airborne Electronic Hardware Design Assurance A Practitioner s Guide to RTCA DO 254 is a testimony to the lessons learned and wisdom gained from many years of first hand experience in the design verification and approval of airborne electronic hardware This practical guide to the use of RTCA DO 254 in the development of airborne electronic hardware for safety critical airborne applications Describes how to optimize engineering processes and practices to harmonize with DO 254 Addresses the single most problematic aspect of engineering and compliance to DO 254 poorly written requirements Includes a tutorial on how to write requirements that will minimize the cost and effort of electronic design and verification Discusses the common pitfalls encountered by practitioners of DO 254 along with how those pitfalls occur and what can be done about them Settles the ongoing debate and misconceptions about the true definition of a derived requirement Promotes embracing DO 254 as the best means to achieve compliance to it as well as the best path to high quality electronic hardware Airborne Electronic Hardware Design Assurance A Practitioner s Guide to RTCA DO 254 offers real world insight into RTCA DO 254 and how its objectives can be satisfied It provides engineers with valuable information that can be applied to any project to make compliance to DO 254 as easy and problem free as possible

Modular Model-based Development of Safety-critical Flight Control Software Markus Tobias Hochstrasser, 2020

Functional Safety and Proof of Compliance Thor Myklebust, Tor Stålhane, 2022-01-03 This book aims to facilitate and improve development work related to all documents and information required by functional safety standards Proof of Compliance PoC is important for the assessor and certification bodies when called up to confirm that the manufacturer has developed a software system according to the required safety standards While PoC documents add functionality to the product neither for the developer nor for the customer they do add confidence and trust to the product and ease certification and as such are important for the product s value In spite of this added value the documentation needed for PoC is often developed late in the project and in a haphazard manner This book aims at developers assessors certification bodies and purchasers of safety instrumented systems and informs the reader about the most important PoC documents A typical PoC

documentation encompasses 50 to 200 documents several of which are named in the safety standards e g 82 documents in IEC 61508 2010 series 101 documents in EN 5012X series and 106 work products in ISO 26262 2018 series These documents also include further references typically one to twenty of them and the total number of pages developed by the manufacturer varies between 2000 and 10000 pages The book provides guidance and examples what to include in the relevant plans and documents

A Quality Assurance Model for Airborne Safety-critical Software Habib A. El Sabbagh, 2006 Software applications in which failure may result in possible catastrophic consequences on human life are classified as safety critical These applications are widely used in a variety of fields and systems such as airborne systems nuclear reactors control and medical diagnostic equipment Unfortunately the world has seen several accidents and tragedies caused by software failure error or where such failure error was part of the problem This thesis looks into safety critical software embedded in airborne systems It proposes a lifecycle specially modeled for the development of safety critical software in aerospace and in compliance with the DO 178B standard and a software quality assurance SQA model based on a set of four acceptance criteria that builds quality into safety critical software throughout its development The thesis also provides frameworks and guidelines for the implementation of the proposed SQA model in addition to sets of rules defining how to assess the software development with respect to the four acceptance criteria

Formal Methods in the Development of Safety Critical Software Systems, 1991 As the use of computers in critical control systems such as aircraft controls medical instruments defense systems missile controls and nuclear power plants has increased concern for the safety of those systems has also grown Much of this concern has focused on the software component of those computer based systems This is primarily due to historical experience with software systems that often exhibit larger numbers of errors than their hardware counterparts and the fact that the consequences of a software error may endanger human life property or the environment A number of different techniques have been used to address the issue of software safety Some are standard software engineering techniques aimed at reducing the number of faults in a software product such as reviews and walkthroughs Others including fault tree analysis are based on identifying and reducing hazards This report examines the role of one such technique formal methods in the development of software for safety critical systems The use of formal methods to increase the safety of software systems is based on their role in reducing the possibility of software errors that could lead to hazards The use of formal methods in the development of software systems is controversial Proponents claim that the use of formal methods can eliminate errors from the software development process and produce programs that are probably correct Opponents claim that they are difficult to learn and that their use increases development costs unacceptably This report discusses the potential of formal methods for reducing failures in safety critical software systems

Safety Critical Systems: a Practical Guide Papini, 2026-04-08 *Automated Safety Critical Software Development for Distributed Control Systems* Brendan Hall, Reinhard Maier, Brian Sellner, 2001 **Planning the Unplanned Experiment** National Aeronautics

and Space Adm Nasa,2019-01-14 We need well founded means of determining whether software is t for use in safety critical applications While software in industries such as aviation has an excellent safety record the fact that software aws have contributed to deaths illustrates the need for justi ably high con dence in software It is often argued that software is t for safety critical use because it conforms to a standard for software in safety critical systems But little is known about whether such standards work Reliance upon a standard without knowing whether it works is an experiment without collecting data to assess the standard this experiment is unplanned This paper reports on a workshop intended to explore how standards could practicably be assessed Planning the Unplanned Experiment Assessing the Ecacy of Standards for Safety Critical Software AESSCS was held on 13 May 2014 in conjunction with the European Dependable Computing Conference EDCC We summarize and elaborate on the workshop s discussion of the topic including both the presented positions and the dialogue that ensued NASA TM 2015 218804 L 20575 NF1676L 21790 Graydon Patrick J and Holloway C Michael Langley Research Center Quality First E. Kessler,1999 **An Agile Framework to Develop Safety Critical Software for Aircraft** Duane Lee Bacon,2018 **Software engineering and standards for safety critical software** P. K. Joannou,1990

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